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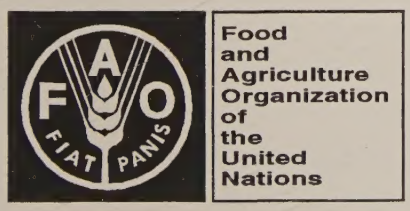

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RESEARCH AND DEVELOPMENT IN FISHING TECHNOLOGY IN LATIN AMERICA

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

All countries, including in Latin America, face serious challenges in fisheries conservation and management. The sharing of information, cooperation in research, technology transfer and training, can help countries meet the new challenges.

This document was prepared in order to provide an overview of the status of research and development in fishing technology in Latin America, identify opportunities for enhancing international cooperation in fishing technology development and research and provide background information to help readers pursue opportunities for increased cooperation.

The Fishing Technology Service of the FAO Fisheries Department sent inquiries in 1996 and 1997 to contacts in Latin American countries to gather information on current activities and on the potential for increased international cooperation. Seven countries responded. This document is based on those responses. It should not be considered a complete inventory of current research and development activities in fishing technology in Latin America.

It is hoped that the information presented in this document will be of value for facilitating international cooperation and perhaps constitute a first step toward compiling more complete data on the subject.

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ABSTRACT

A significant amount of research and development is being conducted in fishing technology in Latin America.

The Fishing Technology Service of the FAO Fisheries Department sent inquiries to contacts in Latin American countries to gather information on current activities and on the potential for increased international cooperation. The document includes responses from Argentina, Brazil, Chile, Colombia, Cuba, Peru and Venezuela.

Some common research areas of interest include fishing gear efficiency and selectivity, bycatch reduction, improvement of artisanal fishing technology, the introduction of more advanced electronics, remote sensing, exploration of deepwater resources, and exploration of non-traditional species and fishing grounds.

All respondents indicated interest in expanding international cooperation. Considering the similarities in biological, technical, social and economic challenges that fisheries organizations now face, and the wealth and variety of expertise within the region, the potential benefits from increased cooperation appear very great.

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INTRODUCTION

International cooperation and information exchange have proven vital to the improvement of fishing technology in virtually every country in the world. Indeed, in any given country in any part of the world, most of the fishing methods in use were developed elsewhere, imported and adapted for local conditions. Such technologies often led to increases in production and/or profits. Now many countries, including some in Latin America, face new challenges in fisheries conservation and management. As traditional coastal species become more heavily fished and sometimes overexploited, there is a need to develop more selective fishing technology, avoid harm to marine resources and environment of special concern, develop effective Monitoring, Control and Surveillance (MCS) and control the fishing capacity of their fleets, and explore the potential for careful harvest of other resources such as those found in deeper waters. In general, countries have now to take action for implementing the agreed principles of responsible fisheries and the relevant Code of Conduct and, at the same time, have to comply with international agreements/conventions.The improvement of small scale fishing technology was also a consistent area of interest for the countries that provided information for this document. The sharing of information, cooperation in research and training, and technology transfer can help countries meet these new challenges. It is hoped that this document will contribute to this process.

This document should not be considered a complete inventory of current research and development activities in fishing technology in Latin America. FAO's inquiries (in 1996 and 1997) to Latin American countries about such activities yielded responses from Argentina, Brazil, Chile, Colombia, Cuba, Peru and Venezuela. There is a great deal more work being done in fishing technology research in the region, but detailed information on much of the work is not available. It is hoped that the information presented in this document (which also includes some information concerning fields of research and development related/associated to fishing technology, such as fish utilization) will be of value for facilitating international cooperation and perhaps constitute a first step toward compiling more complete data on the subject.

Table 1: Overview of Research and Development in Fishing Technology in Latin America

Country	Major fisheries	Priority research related to fishing technology being done	Seeking cooperation in:
Argentina	demersal species (hake), small pelagic	fishing gear selectivity, by-catch reduction devices	fishing gear selectivity, by-catch reduction devices
Brazil	sardines, shrimp, various demersal species, tuna	Survey of Living Resources; new fishing technology; selectivity ; shrimp trawl bycatch reduction; FADs	- training fishing masters in new technology - selective fishing - monitoring, control & surveillance - safety and working conditions - overcoming sociocultural barriers
Chile	small pelagic hake	limited to traps for crustacea	environmental impact, "clean technology"
Colombia	tuna, shrimp, spiny lobster, snapper, langostino	design and construction of trawls, longlines, small vessels; diversification beyond traditional species	midwater trawling, fishing with light, tuna purse seine construction & repair; longlining; small vessel design & building
Cuba	spiny lobster, shrimp, tuna	lobster shelter traps, hauling devices, shrimp trawl selectivity & fuel efficiency, FADs for tuna, environmental impacts	naval engineering, industrial fishery engineering
Peru	anchovy, sardine, hake	diversified small scale gear and methods; selectivity & efficiency of fishing gear; acoustic surveys & calibration	improvement of artisanal fishing methods; remote sensing; on-board fish preservation & unloading
Venezuela	sardine, shrimp, tuna, various demersal species	improving small fishing vessels; snapper/grouper exploratory fishing; bycatch reduction; alternative methods & gear	exchange of scientific and technical fisheries information & documents

Argentina

Background

The deep sea fleets are important in Argentina (almost 360 freezer trawlers with fish capacity averaging 700 cubic meters). The trawl fishery for hake is the main one in terms of number of vessels involved and quantities landed.

For hake trawling, the two panel bottom trawls are being progressively replaced by high opening bottom trawls, Cosmos trawl type, and polyvalent otterboards are replaced by "Super V" doors.

In the shrimp trawling fishery with outriggers trawlers (Patagonian littoral and Buenos Aires coast, in particular S.Jorge Gulf and Camarones Bay, from June to March) the traditional wooden otterboards are being replaced more and more by steel ones, with more hydrodynamic shapes.

It is now recognized that several fish stock are over-exploited, in particular, hake and blue whiting (Micromesistius australis) but also patagonian toothfish, sea trout and flathead. Drastic measures are necessary to reduce the fishing effort. Relevant regulations to control the exploitation of these fish stocks will be strengthened by the fishery authorities. In this respect, it is worth mentioning that advanced communication systems (associating GPS and Inmarsat-C) have been installed on hundreds of vessels; by keeping permanent communication with the fishery administration and the concerned fishery research institution, it makes it possible for a number of vessels to report daily on their catch and to send other information required by the administration.

Due to the over-exploitation of some fish stocks traditionally fished, fleets of large freezer trawlers are now planning to move to other fishing grounds to exploit other fish stocks, such as hoki, known locally as "merluza de cola" (Macruronus magallanicus), now under-exploited, South of 47th Parallel.

Concerning fishing methods other than trawling, an important longline fishery has developed in the Gulf of San Matias, involving almost sixty boats, 8 to 15m in length. The longlines used are bottom or semi-pelagic, 3,000 to 4,000 hooks per day, baited with anchovy (Engraulis anchiota) for catching hake (Merluccius hubbsi), Brazilian sandperch, known locally as "salmon de mar" (Pseudopercis semifasciata), grouper (Acantistius brasilianus). The fish is iced, often in filet, for export to Spain.

It is worth noting that large vessels, in many cases, now have equipment for measuring sea temperature and salinity on board; both of which are considered very important for finding fish.

Research policies and institutions

INIDEP (Instituto de Investigacion y Desarrollo Pesquero) is the institution dealing with fishing technology research.

INIDEP has a section dealing with fish product technology. In this field, the priorities are: - Preservation of the quality of fish on board; - Utilization of sub-products (for instance for medicine or as food additives: skin or cartilage of sharks, oil extracted from squid guts, etc.) ; - Utilization of by-catch (when discarding any by-catch is prohibited relevant processing inboard fish technology has to be developed); - New products (for instance for the optimal utilization of large captures of anchovy).

INIDEP regularly issues three series of publications: - Revista de Investigación y Desarrollo Pesquero; - INIDEP Informe Técnico; - INIDEP Documento Cientifico.

Research programmes

Project on fishing gear selectivity and fishing technology development

The objective is the improvement of species and fish size selection in trawling fisheries; direct observation using underwater cameras.

Regarding fishing technology in general, the objective is to improve the efficiency of the technology in use for a rational exploitation of the resources, including for coastal fisheries.

The project makes an essential contribution to the assessment of the fisheries, advising on the selection, design and construction of sampling equipment and its function.

All these activities are oriented towards a rational use of fishing resources and imply the assessment and selection of fishing gears and materials, their adaptation to local conditions, tests and evaluation of their performance.

The on-going programme includes, among others:

- Development of a sorting device, consisting in two grids for the shrimp (Pleoticus muelleri) fishery which will allow the escapement of fish;

- Development (based on under-water images) of a sorting device for trawls which will allow the escapement of juvenile fish through a single grid. In this repect, it is worth mentioning that the utilization of selective devices on trawls for the escapement of juvenile fish will be made compulsory shortly.

- Design of trawls with computer assistance, including simulation of the trawls shape when in operation.

Selective fishing for "corvina" or whitemouth croaker (Micropogonias fournieri) and for hake (Merluccius hubbsi; in co-operation with JICA) are studied within other projects. In this respect, it is worth mentioning that researchers from INIDEP share their experience concerning selective devices, particularly sorting grids, with scientists working in other parts of the world who are members of the ICES Working group on Grid Sorting Systems in Trawls, Beam Trawls and Seine Nets.

As part of a *project for hake fisheries*, the biologic impact resulting from the utilization of selective devices which are developed within the above mentioned project on fishing gear selectivity is carefully studied.

Within a *Shrimp project*, research is carried out concerning the fishing gear, trawls in particular, which are used for sampling within the stock assessment programme. The medium term impact resulting from the utilization of a sorting grid allowing the escapement form trawls of fish juveniles is also studied.

As mentioned above, while fishing technologists are carrying out research for reducing by-catch (fish juveniles in particular) and discards, fish technologists of the same institution work on for the optimal utilization of unavoidable incidental catch; i.e. elaboration of high value by-products.

Potential for international co-operation

INIDEP already co-operates in the field of fishing technology with INATEC in Nicaragua.

The on-going co-operation within the ICES Working group on Grid Sorting Systems in Trawls, Beam Trawls and Seine Nets has already been mentioned. As a matter of fact, the experience with hake (a species which is assumed having a behaviour and reaction not so different to that of other hake species met in other fishing areas), using the same types of sorting or selective devices being developed or already in use in other parts of the world, would be of potential interest to a number of other fisheries in the world.

Brazil

Background

About 90% of the Brazilian fishery is characterized as artisanal, with the remaining 10% industrial in scale. On some vessels, very simple technology is used, while others have modern, advanced electronics and techniques for fish-finding and navigation. There is increasing concern about the need for conservation of fishery resources, as well as issues such as overfishing and the capture of small fish, sea turtles and marine mammals in fishing gear.

Traditional fishing activity has been concentrated over the continental shelf. There is intense pressure on traditionally exploited species such as sardines and shrimp. Consequently, recent attention is shifting more toward offshore, deepwater, and large pelagic fisheries such as tuna pole-and-line and gillnetting for sharks.

Major trends include increasing access to global markets and growing demand for higher quality products. This may feed a tendency to reduce fleets of older vessels, and replace them with more modern and efficient craft.

Research policies and institutions

Among the top research priorities are surveying living marine resources, and the development of new and more selective fishing technologies.

The Ministry of the Environment, Ministry of Science and Technology, and Ministry of Education and Culture are cooperating on fisheries research programs. Multidisciplinary teams of researchers, including biologists, fishery engineers, oceanographers, physicists and others from diverse backgrounds participate in teams to execute these programs. Various Governmental organizations, universities and research institutes participate.

Such research programs have produced reports on topics such as minimum mesh size, fishing seasons, and fleet control. Such reports are produced by the relevant Governmental organization or research institute, or they appear in scientific journals. There are no fishing industry trade journals. The fishing industry does not usually sponsor projects, but in some cases provides logistical support.

Hindrances to research in fishing technology include shortages of funding, specialised staff, laboratories and research centers dedicated to fishing technology.

Research programmes

The Government is supporting a Survey of the Living Resources in the Exclusive Economic Zone (REVIZEE). This is an interdisciplinary program involving many of the major Governmental agencies and private organizations involved in fisheries research. Within this

Programme are projects dealing with a variety of oceanographic disciplines including physics, chemistry, ecology, remote sensing, fish biology, population dynamics and fishing technology. Moreover, specific projects are being conducted in each of the four regions encompassed by the REVIZEE (Northern, Northeastern, Central and Southern).

In the Northern Region, fishery resources are being surveyed with bottom and midwater trawls, bottom and surface longlines.

In the Northeastern Region, one REVIZEE project consists of a survey for pelagic resources with pelagic longlines. Three small to mid-sized vessels and approximately 12 staff people are involved. The project is sponsored by the Government with cooperation from Federal Universities and logistical support provided by a local fishing company. The transfer of technology developed in this project has been implemented and it is expected to continue through 1999. The estimated three-year cost for this project is reported as US$ 200 000.

A second Northeastern REVIZEE project aims to reduce the bycatch in shrimp trawls by using excluder devices. This project started in 1994. It is being conducted with small vessels in Pernambuco State in cooperation with the Fishing Extension Centre of the Northeast (CEPENE/IBAMA) and the commercial fleet. There are plans to transfer the results to the commercial sector. The estimated 1996 cost for this project is reported as US$ 34 000.

A third Northeastern REVIZEE project involves fishing for tuna and other species with Fish Aggregating Devices (FADs). Six researchers are involved in setting FADs, trial fishing, and dissemination of the results to fishing communities. This project began in 1992. The estimated annual cost is reported as US$ 24 000. Artisanal fishermen help with maintenance of the FADs.

In the Central Region, research has focused on physical oceanography, geology and chemistry. Some experimental longline fishing has been done in areas where trawling is not possible.

In the Southern Region two research vessels are working on REVIZEE projects. Studies include surveys of pelagic and demersal resources as well as physical oceanography, chemistry and geology.

The survey of pelagic resources in this region involves echointegration as well as midwater trawling. For 1996-99, ten researchers have been allocated and a total cost of US$ 800 000 is envisioned. Both winter and summer cruises are planned. There are plans to run transects with a 36 m, 720 HP vessel from the 100 m depth curve to the edge of the EEZ.

Also in the Southern Region, a project is planned for exploratory fishing with bottom longlines (vertical) and traps. Transects between 100 m and 600 m depths will be searched for target species including fish and crustaceans.

A third REVIZEE project in the south involves exploratory fishing with bottom trawls between the 100 m curve and the edge of the continental shelf. Eight researchers and several assistants from different institutions will participate. The total cost for the two-year project is estimated as US$ 120 000.

Potential for international cooperation

Brazil harbours strong interest in, and potential for, international cooperation. Areas for such cooperation include the following:

- training of fishing masters in new technology
- selective fishing and optimal use of fishery resources
- training in monitoring, control and surveillance
- safety and working conditions for fishermen
- overcoming sociocultural and educational barriers to technical change

Chile

Background

The Chilean fisheries products represent 12% of the total national exports, reaching a total value of US$1 800 millions in 1996. The sector involves 200 000 workers direct and indirectly.

Pelagic resources (mainly horse mackerel, anchovy and sardine) are heavily exploited and used as the main raw material for fishmeal which contributes with 73% of the total fish exportation. Total catches of those species were up to 6 281 337 MT in 1996.

The second most important species is hake, with catch in 1996, amounting almost 340 300 t.

The Chilean government has given a high priority to the fisheries and aquaculture sector in the national economic development.

Research policy and institutions

Created in 1978, the Under-Secretariat of Fisheries is the organization that regulates fisheries. It reports to the Ministry of Economy, Development and Reconstruction.

The main Chilean institutions carrying out fishery research include public and private bodies:

- The Fisheries Development Institute (IFOP), is a non-profit technological institute controlled by the Agency for Economic Development (CORFO), which in turn is controlled by the Ministry of Economy. Created in 1965, it has a long tradition in research and development. Its main objective is to carry out scientific and technological research oriented to the exploitation and prospection of fisheries resources and fish stock assessment in juridictional waters. It also seeks, among other, to create methods and technologies for the fishing industry and to develop new systems in aquaculture. In the economic area it analyzes and prepares projects for production and modernization in the fisheries industry.

- The National Fisheries Service (SERNAPESCA) is a public organization created in 1978 wich is responsible for executing national fisheries policy, for supervising its enforcement and and for ensuring proper application of the legal rules and regulations on fishing.

In the private sector, the main agency involved in research and development is "Fundacion Chile". It was created in 1976 through an agreement between the Chilean government and ITT Corporation of the United States. It seeks to facilitate technological transfer for the improvement of the natural resources productivity and exploitation.

There are several universities and other technical institutions mainly dedicated to training and education.

Table 2 - Organigramme of the Chilean Public Fisheries Sector

Ministry of Economy, Development and Reconstruction		
Under-Secretary of Fisheries	Agency for Economic Development CORFO	
National Fisheries Service; Technology Institutes SERNAPESCA (regulatory functions)	Institute of Fisheries Development, IFOP (research functions)	Other Technology Institute

The main national professional association is the "Asociaci6n gremial de profesionales pesqueros", grouping engineers, technicians and other professional categories. The objective of the association is mainly to analyze and to discuss fishery policies on a regular basis, providing government authorities with technical and professional advice.

There are also specific professional associations of fish producers providing assistance to their members with advisory services in all fields, including technology, as well as training through courses, seminars or lectures.

The research policy in Chile is based on the National Policy of Science and Technology. Its basic general principles are:

- to improve Chile's competitiveness and productivity and the national standard of living through science, technology and innovation development.

- to enhance both the number and the capabilities of national professionals and technicians.

- to involve progressively private companies in the funding and in the use of scientific and tchnological developments.

- to create the conditions for the contribution of science and technology to the sustainable development of the country.

- to strengthen democracy by increasing the availability of information.

Therefore in the field of fishing technology priority is given to the improvement of the industry competitiveness and productivity in global markets through the sustainable use of fishery resources. The objectives of this policy is better use of existing infrastructure and technological innovation to improve and diversify production in order to include more added value in fishery products,

In the last 6-7 years, the old mechanisms for funding research were improved and several others were created with a large emphasis on socioeconomics aspects. Research has been forced to meet national policies and subjected to strict evaluation regarding technical and socioeconomic viability and projects strategies.

Basically, the old mechanisms for funding technological research have been replaced by a new system based on the research needs of the industry.

The main available funds come from:

- Fund for Promotion of Scientific and Technological Development (FONDEF),
- National Fund for Technological and Productive Development (FONTEC);
- Fund for Development and Innovation (FDI),
- Fund for Fishing Research(FIP), which is exclusively for the fishery sector.

Except FIP, all funds are managed by the Chilean Agency for Economic Development (CORFO) through its executive council. CORFO is the specialized agency for the promotion of the production. It works through subsidies that contribute to innovation and technological changes in areas of strategical impact in the economic and social development of the country.

All of these funds were created by the Chilean government in order to promote scientific and technological development. They are available to universities and other non-profit scientific and technological institutions.

The common objectives of these funds are the increase of Chilean industry competitiveness in the global markets by encouraging national scientific and technological development and by applying the results to the needs of Chilean companies in the private and in the public sectors.

These schemes include projects which incorporate scientific and technological activities as an important component of their work and obtain prototype results which can be transferred to the productive sector. They also include the development of innovative technological processes or the adaptation of new technologies relevant to the country's industries.

Other projects include the creation and the installation of infrastructure to improve technological research and development know-how in specialized services.

Research proposals by universities or research institutes must show that the result of their projects will have an effective industrial use and result in gains of productivity, creation of new jobs or an increase in exports. Companies must finance part of the project to ensure that the research will be used on an industrial basis. Firms can finance part of the project directly or allow researchers to use company infrastructure, raw material or workforce. Companies must sign a contract detailing their commitment as a condition for applying to the fund.

The approved projects must have an economic evaluation under conditions of uncertainty with a cost-benefit analysis and socioeconomic revenue of at least 12%.

During 1995 the Chilean government has set up the "Programme of Technological Innovation" (FDI) based on the important role of the state as catalyst of private action to reach an advanced stage of national development (FDI has invested 3.861 million Chilean Pesos in 1995 and 5.300 million Chilean Pesos are foreseen in 1997) ($1 US = Chilean Pesos 415).

Co-funding of research projects by private industries of the fishing sector has grown between 1995-1996 in FDI programme from 15% to 33%. It is the main funding source of fisheries research in technology and quality aspects in the fishery industry and aquaculture.

CORFO uses the results of the research to identify new areas where investment is needed. It focuses on the funding of the creation of new products or business with socioeconomic impacts.

CORFO promotes extensively the results of the FDI, FONTEC and FONDEF projects to companies through shows and publics expositions. The objective is to stimulate the private companies in co-funding the research projects and to invite them to use this fund for solving their own requirements of technological development.

Fishery Research Fund (FIP), depending on the Ministry of Economy, is the only fund aimed to finance research on conservation of marine resources. This fund is used for researches in fisheries or in aquaculture in order to provide the information needed by Government authorities for the setting of administrative measures regarding the conservation of marine biological resources and ecosystems. The results of the FIP projects are generally used by fisheries authorities rather than the private sector.

Relationship between research and the fishery industry

As we have seen, the current system for funding fishery research considers the participation of the industry in the generation of ideas and its active involvement in the project as essential. As a result, researchers are obliged to keep a constant relationship with the industry in order to identify opportunities to solve technological problems and to be aware of the industry needs.

The system obliges researchers to make sure they are well informed about international trends in the fishery industry and in aquaculture, about the markets of fish and fishery products, about new technologies or about consumption and sanitary rules. The researchers then have to compete among them and sell their ideas to companies in order to develop research projects.

The assignment of funds to research are decided by committees including producers, renowned researchers, lawyers and economists.

Funding of research programmes by private industry

Today the most usual way of funding research programmes by private industry is through joint projects with state technology institutes or with universities.

Besides FDI and FIP funds, one of the first initiatives in Chile to promote technological innovation specially to be used by Chilean companies was the National Fund for Technological and Productive Development (FONTEC). It provides preferential funding to small and medium-sized companies working in strategic sectors of high national interest.

Relationship between research and the fishery administration

Research results from the FIP form the basis of regulations developed by the administration. Also involved in the process are the National Fishing Council integrated by the Under-secretary of Fisheries, the National Oceanographic Council, experts in the fishing field (including 2 from the university sector), and representatives of producers'associations.

Each year, the Zonal and Regional Fisheries Councils give their suggestions for the annual programme of fishery and aquaculture research, including their priorities. With this information the Under-secretary proposes the annual programme of Fishery Research to the National Fishery Council which gives the final approval to the priorities.

Research is sometimes constrained by funding. Importance is given to eonomic utility when competing research proposals are evaluated. It is not considered desirable for the State to maintain large and expensive research infrastructure, so joint public-private co-operation in research is very important

Publications for extension to fishery industry

"Chile Pesquero" is a specialized magazine 20 years old, published every two months. It is the fisheries and fish farming magazine oriented to business, technology and economics for Chilean and Peruvian fisheries industries. Its editorial line is mainly based on pelagic fishing for fishmeal and fish oil (including processing, investments, shipbuilding, fishing gears, and fishing technology), fish farming (mainly salmon but also other Chilean profitable farming activities); fisheries for human consumption, sectorial economics and statistics.

Research programmes

A direct consequence of the national development policies in the fisheries field was the great emphasis placed in the aquaculture. More than 60% of the total funds invested in fishery research projects in 1996 were for aquaculture development, compared with 29.5%assigned to projects regarding quality and technology.

In the field of fishing gears, there is only one record of research project in the last years, *the 'pre-feasibility study of crustaceans artisanal trap fishing".*

This project was funded by FIP in 1995 up to 23 million Chilean Pesos but it was not extended in the following years. It was run in Chile's 5th Region (Vaiparaiso-San Antonio) from October 1995 to June 1996. Its objective was to evaluate the technical and the economical feasibility of the utilization of traps on artisanal boats in order to catch shrimps *(Heterocarpus reedi)* and langostinos *(Cervimunidajohni).*

The project included:

- the design and construction of traps
- the mobilization of a 16.8 meters boat equipped with echo-sounder and line hauler
- 2 months of experimental operations (to test the traps)
- 3 months of exploratory operations (to evaluate the resource)

Detailed results and evaluations of this research project are not available.

Potential for international cooperation

As for potential international cooperation, in addition to aspects concerning quality of fish products, it is worth mentioning that international cooperation will be necessary in relation to "eco-labeling" and environmental considerations during fish processing, e.g "clean technologies".

Colombia

Background

With coastlines on both the Caribbean Sea and Pacific Oceans, Colombian fisheries are extensive and diverse. The continental shelves are relatively narrow (48,365 square km). Fishery resources are characterized by high species diversity and relatively small stock size.

The main species fished include tuna, langostino, shrimp, lobster, snappers, and conch. A significant part of the product is exported to the USA, Japan, and Europe.

Approximately 25,000 artisanal fishermen provide an important source of food for internal consumption, and bring significant socio-economic benefits to coastal areas.

Major fishing techniques include purse seining for tuna and small pelagic species, shrimp trawling in both shallow and deep waters, bottom longline fishing and hook-and-line. Many of these techniques were imported during the nineteen-fifties from countries such as Mexico, Ecuador, and the USA. In 1996 there were approximately 144 vessels targeting shrimp, 69 tuna vessels, and 80 vessels targeting mixed demersal species.

In recent years shrimp trawlers have been required to use Turtle Excluder Devices (TEDs). The consequent reduction in bycatch is expected to benefit artisanal fisheries, and the improvement in the quality of shrimp landed should improve the economics of the shrimpers. Tuna purse seiners have had to adopt techniques to avoid the incidental mortality of dolphins, and the benefits have been documented by the InterAmerican Tropical Tuna Commission.

Some species targeted by traditional fisheries are harvested at or beyond maximum sustainable yield. However, others which could be harvested are not, due in part to a lack of appropriate and economically viable technology. These include thread herring, jumbo squid and deepwater shrimp.

Areas of interest for fisheries research include the selectivity of fishing gear and methods, reduction of bycatch in shrimp trawls, measurement of fishing effort, fishery economics, Monitoring, Control and Surveillance, fishermen's safety and working conditions. Private fishing companies conduct their own research in fishing gear and methods, sometimes contracting additional expertise from countries including Peru, Ecuador, Mexico, Panama, or the USA.

Research policies and institutions

National legislation and policies support the application of appropriate fishing technology to increase production and assure the rational utilization of physical, human and economic resources. The Ministry of Agriculture and the National Institute for Fisheries and Aquaculture (Instituto Nacional de Pesca y Acuicultura INPA) have arrangements for technical support to

both artisanal and industrial fisheries. However, the development of an overall plan for research and development in fishing technology has been hindered by shortages of experienced technologists, infrastructure and financial support.

Several institutions offer fisheries training. The Department of Fishery Engineering (Falcutad de Ingeniería Pesquera), located in Santa Maria on the Caribbean coast, trains professionals in fishing technology, design and calculations for fishing gear.

The Nautical Fisheries Centers of the National Training Service (Centros Nautico-Pesqueros del Servicio Nacional de Aprendizaje SENA) are located in Buenaventura and Cartagena. The Centre in Cartagena provides training in net construction, seamanship, fishing operations, marine engines, refrigeration and navigation. It is equipped with a testing tank. The Japanese International Cooperation Agency (JICA) has provided support to this centre, and its professors have been trained in Japan.

The Technical University of Chocó (Universidad Tecnológica del Chocó) trains mid-level fishing technologists with basic skills in fishing technology, marine engines and seafood preservation.

A number of marine biologists, fishing technologists and fishery engineers have received training abroad in Japan, Korea, Cuba, Mexico, Peru and Chile. The Colombian Association of Fishery Engineers (Asociación Colombiana de Ingenieros Pesqueros) cooperates with the University of Magdalena, the Technical Institute of Mazatlan, and the Organization of American States to offer an international course in the design of machinery for fishing. The course is intended for thirty professionals and consists of 200 hours of theory and practical exercises.

Research programmes

The INPA has conducted research on artisanal fishing technology and related economics, as well as studies of nets and longlines for exploratory fishing.

The Department of Fishery Engineering is currently conducting the following projects:

- Calculation and design of a purse seine (graduate thesis)
- Calculation and design of a pound net (Daibo Ami type)
- Assessment of the fishing gear and motors of the Colombian shrimp fleet in the Caribbean
- Calculation and design of a bottom trawl for the research vessel Ancón
- Constructive analysis, calculation and design of an industrial purse seine for tuna fishing in Colombia
- The potential for mechanization of longline fishing with small vessels
- Calculation, design and construction of a liftnet for fishing with light
- Diversification of fishing with shrimp vessels

In cooperation with the European Union Program for Technical Cooperation in fisheries and Development of Artisanal Fisheries, the following activities are in progress:

- Training of fishermen in the use of GPS (Global Positioning System) and use of video sounders on small vessels
- Training in the construction and use of longlines
- Design, construction and testing of a purse seine for artisanal fishing for small pelagic species
- Design and evaluation of shrimp traps made of PVC (polyvinyl chloride)
- Improvement of seines for small scale fishing for jacks

The results of these projects will be published in the program's Technical Bulletins, and will serve as the focus of further extension activities. Certain related technologies such as the use of GPS in mid-sized vessels, have shown promise and been widely accepted.

Potential for international cooperation

An urgent need for regional cooperation in fishing technology research and development has been voiced. In particular, technical assistance aimed at solving specific practical problems could bring great benefits. A few potential participants are the National Institute for Fisheries and Aquaculture, the Nautical Fisheries Centers of the National Training Service and the Department of Fisheries Engineering. Some specific topics for general courses and/or focused training might include the design, construction and testing of the following:

- shrimp nets for deep and shallow waters
- midwater trawls
- mid-sized purse seines
- fishing with light
- bottom and surface longlines
- pots for fish and deepwater shrimp
- small scale fishing vessels

In addition, there is an urgent need for technical assistance in the design, construction and repair of tuna purse seines, because the local industry does not have sufficient trained technicians in this specialty.

Cuba

Background

The major fisheries in terms of monetary value for Cuba involve exports of spiny lobster, penaeid shrimp and tuna. In the lobster fishery, 245 vessels up to 18 m in length supply seven industrial plants with a total annual production of more than 9 000 tonnes. In the shrimp fishery, 92 trawlers of 18-23 m in length catch about 1 800 tonnes of shrimp per year, with a bycatch of 12 000 tonnes which is used for human consumption and animal feed. The tuna fleet consists of 35 vessels up to 19 m long catching skipjack and yellowfin with live bait, pole and line.

Aquaculture and capture fisheries for other species of finfish supply the domestic market. Five hundred thirty vessels up to 18 m in length catch about 22 000 tonnes per year. The main species are snappers, groupers, grunts and sharks. Fishing gear includes traps, beach and boat seines, gillnets and other entangling nets, hook and line.

Research policies and institutions

The Government has actively supported fisheries development since 1959 with projects aimed at improving fishermen's working and living conditions, building fishing vessels and processing plants. Fishery research, management and regulation fall under the authority of the Ministry of Fisheries (Ministerio de la Industria Pesquera, MIP). Within this Ministry, there are two agencies concerned with research in fishing technology.

One of these agencies, the Fisheries Research Centre (Centro de Investigaciones Pesqueras, CIP), has a responsibility to conduct scientific studies and advise the MIP regarding development policies for the exploitation, management, culture, and processing of fishery resources as well as the conservation of the aquatic environment. The CIP's main activities include the following:

- stock assessment
- assessment of the effects of fishing on the stocks and on the environment
- studies to improve fishing gear and methods
- quality control and certification of seafood products
- development of fish processing technology
- aquaculture

The CIP has a staff of approximately 150 as well as an experimental processing plant, laboratories, a mariculture station and two research vessels. Library services and publication of results to support and enhance research are high priorities. For some time the CIP published the Cuban Journal of Fisheries Research (Revista Cubana de Investigaciones Pesqueras). As of 1996 there was a four-year interruption in the printing of this journal, but plans were in the works to revive it with the support of a FAO/DANIDA project. Since 1995, CIP has been the national

partner of ASFA (Aquatic Science and Fisheries Abstracts). Fishery engineers as well as biologists from the Division of Marine Fisheries have also worked in fishing technology research and development, with positive results in the fields of gear selectivity, environmental impacts, evaluation of fishing effort, and fishing economics.

The Centre for Marine Technology and Projects (Centro de Proyectos y Tecnologia Naval, CEPRONA) is another agency in the MIP responsible for projects involving vessels, equipment and technology for marine fisheries. Its funding comes from contracts with both the MIP and the fishing industry. Its staff of about 100 work mainly in research and development in mechanical, naval and electrical engineering. It designs vessels as well as a variety of other oceanic and maritime structures. CEPRONA is a partner of the Panamerican Institute of Naval Engineering (Instituto Panamericano de Ingeniería Naval, IPIN). Like CIP, CEPRONA used to publish a scientific journal, but shortages of funding forced the cessation of publication some years ago.

Research programmes

Most recent research has focused on capture technologies for the most valuable species - spiny lobsters and shrimp. In the lobster fishery, considerable research has been conducted to improve the gear - mainly shelter traps, seines, and fish pots. Hauling devices to lift the gear have also been developed. Trap studies have included selectivity, environmental impacts, replacement of wire mesh with polyamide, ghost fishing, biodegradable components and escape vents.

In the shrimp fishery, researchers have studies fuel efficiency, selectivity, introduction of twin trawls (now common), and measurement of fishing effort.

A recent innovation in the tuna fishery is the introduction of floating fish aggregating devices (FADs). With regard to other finfish, studies of selectivity and catch per unit effort have been conducted.

Vessel construction has evolved over the past 30 years from wood to ferrocement, steel and plastic. Development and introduction of new vessel types in the 10-20 meter range is still going on.

Potential for international cooperation

Cuba has experienced specialists in the construction of small vessels, fishing gear and methods, selectivity, bycatch, environmental impacts and evaluation of management strategies. Cuba has supported research for the development of lobster fisheries in Mexico, Belize and the Republic of Yemen, and it is prepared to provide such assistance to other Latin American countries which harbor similar species. In turn, Cuba would be interested in receiving additional training for its specialists in naval engineering and industrial fishery engineering to maintain the continuity of these fields.

Peru

Background

The major species of commercial importance in Peru are the pelagic species anchovies, sardines and jacks; as well as the demersal species hake. The production of small pelagics ranges from six to eleven million tonnes per year, with serious fluctuations in stocks and catches according to changes in environmental phenomena such as El Niño, which often occurs in 3-7 year cycles. Demersal fisheries produce on the order of 100 000 to 180 000 tonnes per year. Industrial fisheries commonly use purse seines and bottom trawls. Artisanal fisheries use a variety of gillnets, seines, traps, longlines, harpoons and many others.

Research policies and institutions

Fishery research is aimed at stock assessment, improvement of industrial and artisanal fisheries, and identification of possible new fishery resources.

There are three main Governmental institutions working in fishery research and development. The Marine Institute of Peru (Instituto del Mar del Perú, IMARPE), which has a General Directorate of Fisheries, conducts period stock assessment of the major commercial species to support conservation and management of the resources. The National School of Artisanal Fisheries (Escuela Nacional de Pesquería Artesanal, PAITA) conducts training activities aimed at improving fishing gear. The Fisheries Development Fund (Fondo de Desarrollo de la Pesca, FONDEPES) has an artisanal fisheries unit as well as aquacultural activities.

Several universities have fishery engineering departments which conduct research and training activities in fishing technology. Some of these groups have established working relations with particular sectors of the fishing industry. The people conducting research focused on fishing technology, selectivity and efficiency are mainly fishery engineers. Some biologists also participate. Stock assessments, on the other hand, are conducted mainly by biologists, with support from fishery engineers.

IMARPE is the institution with the most firmly established fishery research projects, aimed mainly at stock assessment with acoustic and fishing surveys. It has headquarters in Callao and seven coastal laboratories, as well as arrangements with other groups that participate in its research. It reports regularly to the Ministry of Fisheries and disseminates information to the private sector as well. Its publications include the monthly Progressive Report (Informe Progresivo), as well as series of Bulletins and Reports (Boletínes e Informes) which present more rigorous scientific and technical studies. Research results are given a great deal of weight in decisions about resource conservation and management.

The private sector uses mainly imported technologies such as purse seines for pelagic fisheries and bottom trawls for demersal fisheries. Artisanal fisheries use traditional methods

with the gradual introduction of imported materials. However these materials are sometimes poorly adapted for local conditions and therefore not very efficient. As is the case in many places, the results of research in fishing technology are often not easily assimilated by the private sector. However, there is a need for more thorough investigation of technologies to catch species such as jacks and sauries. The use of deepwater longlines and trolling may also have potential and need to be researched.

Research programmes

The following projects are conducted through IMARPE's Directorate General of Fisheries.

1. Experimental fishing with diversified small scale gear and methods in selected areas

More effective and diversified small scale fishing technologies could enable fishermen to increase production and target a wider range of species during different seasons, increasing the supply of fish for the domestic market. Therefore, the goal of this project is to diversify and improve small scale fishing methods and gear. The method involves experimental fishing with traditional gear and modified gear, studies of fish behavior in relation to the gear and studies of catch rates. Appropriate capture methods for deepwater and underutilized species are also being sought. During 1995 and 1996, experiments were conducted with beach seines as well as Japanese and Norwegian fish pots for deepwater species. This is a cooperative effort among IMARPE and certain universities, with an annual budget on the order of US$ 17 500. Preliminary reports have been developed, but additional testing should be done in order to produce more conclusive results.

2. Structural survey of Peruvian artisanal fisheries

Small scale fisheries produce 70% of the fish for direct human consumption in Peru. Fisheries also have great economic and social value for many coastal communities. In order to prepare the way for more effective technical support to artisanal fisheries, this project aims to compile a survey, by zone, of small scale fishing vessels, gear and methods. Survey activities began in 1995, with data compilation and analysis continuing in 1996.

3. Selectivity and efficiency of fishing gear for survey and commercial use

The goal of this project is to evaluate the selectivity and efficiency of trawl nets in order to interpret more accurately survey data for stock assessment and to regulate commercial fishing gear. The covered codend and other methods are used to determine retention rates, selectivity and other parameters. Mesh size and elongation of net panels are measured and related to the size composition of catches. During 1996 both Government research vessels and private trawlers were used. The main species of interest for this project is hake.

4. Stock assessment of pelagic and demersal resources

On a regular basis IMARPE is required to present to the Ministry of Fisheries the scientific information and recommendations on which to base resource management decisions. This is especially important for species such as anchovy, sardine and hake, whose fisheries have great social and economic impacts on the country. Assessments of underutilized species such as jacks for which future fisheries may expand are also important. Acoustic surveys are often used for estimating the abundance and location of pelagic stocks. These comprise important inputs to the development of catch quotas designed to achieve Maximum Sustainable Yield. Test fishing with trawls is used to calibrate acoustic equipment, confirm species identification and size composition. For demersal species, bottom trawl surveys are more commonly used.

Potential for international cooperation

In pelagic fisheries, inefficient technology for on-board fish handling, preservation, transport and unloading cause significant waste of catches. More efficient utilization of the resources, and economic yields, could be improved through the renovation of vessels and machinery.

In demersal fisheries, the trawls in use are not very selective. This leads to significant bycatch and discard problems.

The accurate measurement of fishing power over time is another major challenge. Vessel horsepower and machinery are often upgraded without adequate reporting to the authorities. In time it becomes extremely difficult for scientists to know the actual fishing effort. This causes problems with stock assessments and other aspects of resource management.

Artesanal fishing technologies for capture, handling and preservation of catches are in need of upgrading. Related to this is the capture of shrimp larvae in coastal areas, which is accomplished with nets of extremely fine mesh. The concern is that these nets take not only shrimp larvae, but also the larvae of many other species which may be important for fisheries and the well-being of the ecosystem. there is a need to develop more selective methods of catching shrimp larvae, or using more larvae produced in laboratories.

There is also interest in:

- the application of remote sensing to high seas fisheries
- deepwater fishing technologies to explore depths greater than 500 m
- exclusion devices to prevent the capture of protected species.

Venezuela

Background

Among the important commercial species are sardines, shrimp, tuna and various demersal finfish. Both industrial and artisanal fisheries are important. Venezuelan fisheries are conducted in inland waters, estuaries, coastal waters, offshore areas and in the vicinity of the country's islands.

Research policies and institutions

The Government agency responsible for overseeing and supporting research is the National Council for Scientific and Technical Research (Consejo Nacional de Investigaciones Cientificas y Tecnologicas, CONICIT). In a workshop on Priority Areas for Marine Science and Technology organized by CONICIT in July 1996, National Priorities for Fishery Research were identified as follows.

1. Develop management models that improve the utilization of marine fishery resources exploited in traditional areas.

    1.1 Improve the knowledge of the biology and population dynamics of commercial species.

    1.2 Expand the database of reliable statistics on landings and fishing effort.

    1.3 Increase the knowledge of non-biological factors and their effect on fisheries.

    1.4 Develop technology to increase the efficiency of fishing operations and processing. Priority fisheries involve sardines, snapper-groupers, trawling, and commercially important invertebrates.

2. Develop management models that improve the utilization of marine fishery resources in non-traditional fishing areas.

    2.1 Give priority to fisheries research aimed at artisanal fisheries on the continental shelves of islands.

    2.2 Conduct exploratory fishing on the shelf edge and slope for the industrial fishery.

    2.3 Evaluate the potential for sardines and other pelagic species in deepwater areas.

    2.4 Develop technology to catch pelagic species in non-traditional areas.

2.5 Promote the development of processing technologies for deepwater species.

3. Develop a strategic plan for fisheries which reinforces access of Venezuelan fleets to extraterritorial waters and includes in an integrated manner, research, promotion and international exchange in the field of fishing technology.

4. Promote the application of new technologies such as remote sensing for fishery research and coastal development, especially in estuarine areas.

5. Promote more fisheries research in the western regions, especially in Lake Maracaibo and theGulf of Venezuela, and concerning the following:

5.1 Snappers and groupers in the shelf of Los Monjes

5.2 Crabs in Lake Maracaibo

5.3 Shrimp in Lake Maracaibo

5.4 Molluscs in Lake Maracaibo and the Gulf of Venezuela

5.5 Sardines in the Gulf of Venezuela

5.6 Demersal resources in the Gulf of Venezuela

5.7 Jacks and mackerel in the Gulf of Venezuela

5.8 Other pelagic resources in the Gulf of Venezuela

6. Morrocoy National Park

6.1 Identification of biotoxins in molluscs and areas of harmful algal blooms

6.2 Artisanal fisheries study

6.3 Socioeconomic study

6.4 Contingency planning for mass mortality due to harmful algal blooms

6.5 Characterization of plancton and productivity

7. Orinoco Delta and Gulf of Paria

7.1 Compile baseline data on the area prior to petroleum-related development

7.2 Increase research on artisanal fisheries in the region

In 1995 major changes in the fishery management system were introduced. The system is now based on more direct participation of producers in the development of management measures and on the need for responsive, dynamic management to optimize the sustained yield from fisheries and to conserve the environment.

In addition to CONICIT, a number of other governmental and non-governmental organizations participate in the planning and implementation of fisheries research. CONICIT receives information and advice from the National Oceanographic Commission (Comisión Nacional de Oceanología, CNO). The CNO incorporates members from other national organizations involved in ocean activities, and it acts as a liaison between these other organizations and CONICIT. The CNO develops strategies and research plans for implementation by the appropriate branch of CONICIT.

The organization which plans, develops, supports, implements, coordinates and evaluates activities involving the fisheries sector is the Autonomous Fisheries and Aquaculture Service (Servicio Autonomo de los Recursos Pesqueros y Acuicolas, SARPA). SARPA is attached to the Ministry of Agriculture (Ministerio de Agricultura y Cría, MAC), and works with the Fisheries Advisory Group (Junta Consultiva de Pesca) which evaluates the effectiveness of fisheries programs. SARPA has a delegate on the CNO and also creates specific commissions to address particular management issues such as aquaculture in reservoirs.

The private fishery sector sometimes asks SARPA to solve specific problems or provide information concerning fishery statistics, technical advances, etc. SARPA uses the research results from various institutions to define policies and address management challenges in order to achieve sustainable utilization of fishery resources.

The official Governmental agency responsible for executing fishery research and technical assistance is the National Fund for Agricultural Research (Fondo Nacional de Investigaciones Agropecuarias, FONAIAP). FONAIAP is attached to the Ministry of Agriculture, and carries the mandate to develop and disseminate scientific and technical information for agriculture and fisheries. FONAIAP follows the guidelines developed by SARPA. Since 1986 it has implemented technical development projects receiving partial funding from the Interamerican Development Bank (Banco Interamericano de Desarrollo, BID). It often works with state and regional development groups to address joint needs.

National universities, private foundations, and other non-governmental organizations also work with these agencies to develop and implement fisheries projects.

Some research activities in fishing technology have been hindered by factors such as insufficient financial support, inadequate coordination among different groups involved in administration, development and research, and insufficient application of research to the actual problems of the fishing sector. New relationships among the various institutions, through SARPA in particular, are being developed to address this. An additional hindrance is the difficulty in keeping trained and highly qualified people in these institutions - they sometimes emigrate or move to the private sector. Other constraints include insufficient infrastructure, lack of resources for extension and dissemination of research results, limited scientific and technical exchange with specialists in other countries, the lack of an integrated approach to fisheries problems, and a generally low priority assigned to fisheries research.

Fishery researchers have generally positive working relations with the artisanal fisheries sector - there is good cooperation and communication between them. There are also generally good working relations between the processing sector and researchers. However, working relations between most research organizations and the industrial fishing sector are reported to be less strong. There has been cooperation in some areas such as development of more selective gear, avoidance of protected species, and deployment of fishery observers on some vessels.

Research programmes

Fishery research generally addresses three main themes:

1) Stock assessment and determination of the potential yield of currently utilized resources to develop management measures.

2) Life cycles and population dynamics of commercially important species.

3) Technology for fishing, seafood handling and processing, including quality control.

Venezuela is conducting extensive research in all three fields. Specific research activities in Venezuela concentrating on fishing technology are as follows:

- Testing of non-traditional fishing methods and gear to increase efficiency and reduce the bycatch of undersized fish. Research on various types of escape panels is being conducted, with dissemination of the results. Three biologists, one fisheries engineer and four fishing technologists are assigned to the project. The budget for 1996 was reported as 1 720 560 Bs. (US$ 3 615).
- Small scale exploratory fishing for octopus with longanizo. Octopus cannot be captured with trawls near the coast. This project will conduct research and extension, with three biologists and four fishing technologists. The budget for 1996 was reported as US$ 70 000.
- Exploratory fishing with hook and line, especially for snappers and groupers in the vicinity of islands. Assessment of the relative abundance of snappers and groupers is needed in order to

evaluate the potential for commercial exploitation. Three biologists and two fishing technologists will be involved in exploratory fishing. The budget is reported as US$ 250 000.

- Design, construction and testing of improved small scale fishing units with advanced equipment. Prototype vessels with equipment such as inboard motors, insulated fish holds, satellite navigation systems and radio transceivers will be built and tested. Demonstrations of the vessels and gear will be conducted. One fishery biologist, three fishing technologist/instructors, one economist and one sociologist are assigned to the project, with a budget of US$ 69 500.

Potential for international cooperation

Interest has been expressed in increased international exchange of information, journals and documents on many aspects fishing technology and fisheries research.

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Jordan S., Romulo, 1996. Research and fishing technology in Peru (Investigación y tecnología de pesca en el Perú) . Report to FAO.

Mora, Orlando, 1996 . Fishing technology research in Colombia (La investigación de la tecnología pesquera en Colombia) . Report to FAO.

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APPENDIX 1

Organizations referred to in the document

Argentina

Fishery Research Institute of Argentina (Instituto de Investigaciones Pesqueras de Argentina, INIDEP)

Brazil

Brazilian Institute of Environment and Natural Resources (IBAMA)
Fishing Extension Centre of the Northeast (CEPENE/IBAMA)
Fishing Research and Extension Centre of Souteastern/Southern Brazil (CEPSUL)
Marine Resources Interministerial Commission (CIRM)
Ministry of Education and Culture (MEC)
Ministry of Science and Technology (MCT)
Ministry of the Environment
REVIZEE Executive Committee

Canada

Institute of Fisheries and Marine Technology (Newfoundland)

Chile

Faculty of Fishery Engineering of Chile (Facultad de Ingenieria Pesquera de Chile)
Fishery Development Institute of Chile (Instituto de Fomento Pesquero de Chile)

Colombia

Department of Fishery Engineering (Facultad de Ingenieria Pesquera)
National Institute of Fisheries and Aquaculture (Instituto Nacional de Pesca y Acuicultura, INPA)

Cuba

Center for Marine Technology and Projects(Centro de Proyectos y Tecnologia Naval, CEPRONA)
Fishery Research Centre of Cuba (Centro de Investigaciones Pesqueras)
Ministry of Fisheries (Ministerio de la Industria Pesquera)

Ecuador

Artisanal Fishery Centre of Manta (Centro de Pesca Artesanal de Manta)

Mexico

Marine Science and Technology Unit of the Secretariat of Education of Mexico (Unidad de Ciencia y Tecnologia del mar de la Secretaria de Educacion de Mexico)

Peru

The National School of Artisanal Fisheries (Escuela Nacional de Pesquería Artesanal, PAITA)
Department of Fisheries Engineering, Agrarian University (Universidad Agraria)
Department of Fisheries Engineering, Faustino Sanchez Carrion University
Department of Fisheries Engineering, Pedro Ruiz Gallo University
Department of Fisheries Engineering, San Luis Gonzaga University
Faculty of Fishery Engineering of Peru (Facultad de Ingenieria Pesquera de Peru)
Fisheries Development Fund (Fondo de Desarrollo de la Pesca, FONDEPES)
Marine Institute of Peru (Instituto del Mar de Peru, IMARPE)

Spain

Institute of Oceanography of Spain (Instituto Espanol de Oceanografia)

USA

Florida Institute of Technology

Venezuela

Autonomous Fisheries and Aquaculture Service (Servicio Autonomo de los Recursos Pesqueros y Acuicolas, SARPA)
Fisheries Advisory Group (Junta Consultiva de Pesca)
Ministry of Agriculture (Ministerio de Agricultura y Cria, MAC)
National Council for Scientific and Technical Research (Consejo Nacional de Investigaciones Cientificas y Tecnologicas, CONICIT)
National Fund for Agricultural Research (Fondo Nacional de Investigaciones Agropecuarias, FONAIAP)
National Oceanographic Commission (Comision Nacional de Oceanologia, CNO)

APPENDIX 2

List of periodicals published in Latin America including information on fishing technology and relevant research

	Titles	Readers target	Frequency of issue
Argentina	**.REDES**	industry	monthly
	.Revista de investigación y desarrollo pesquero (Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata)		
	.Memoria del Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata	scientific	
	INIDEP Informe Tecnico (Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata)	industry res./dev.	
	.INIDEP Documento Científico (Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata)	scientific res./dev.	
Brazil	. Instituto de Pesca; Boletín **Sao Paulo**	scientific	
	. Instituto de Pesca; Boletín Técnico Sao Paulo	scientific	
Chile	**.Chile Pesquero** (Santiago)	industry	monthly
	. Investigación Pesquera (Santiago) Instituto de Fomento Pesquero	industry	
	. Investigaciones marinas Universidad católica de Valparaíso. Escuela de Ciencias del Mar; Valparaíso	scientific	
	. Ciencia y tecnología del mar Comité Oceanográfico Nacional; Valparaíso	scientific	
	. Revista del Pescador Fundación para la capacitación del Pescador Artesanal	industry	
Colombia	**. Revista Ingeniería Pesquera** Universidad del Magdalena; Santa Marta	scientific	
	. Technical Bulletin of the Union Program for Technical Cooperation in Fisheries and Development of Artisanal Fisheries	scientific	
Cuba	**. Revista Cubana de Investigaciones Pesqueras/Cuba**	scientific	monthly
	. Journal of Fisheries research (out of print)		
	. Mar & Pesca	scientific	
Perú	**. Instituto del Mar del Perú** Serie de informes especiales; Callao	scientific	
	. Perú Pesquero Instituto para el desarrollo de la pesca y la mineria; Lima	industry	
	. Embarcaciones pesqueras OLDEPESCA; Organización Latinoamericana de Desarrollo Pesquero; Lima	industry	
	. IMARPE Informe Progresivo/Progressive Reports	scientific	
	. IMARPE Boletines e Informes/Bulletins and Reports	scientific	

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